





# Water Distribution

# 3

 **Duration:**  
Pre-visit: 45 minutes  
Visit: 30 minutes  
Post-visit: 1-2 classes

 **Setting:**  
Classroom, Outdoor area on campus, Mission Espada aqueduct, Mission San Juan labores

 **Skills:** Grades 6-8  
Math: 6.11 Applies math to solve problems connected to everyday experiences, investigations in other disciplines and activities in and outside of school.  
7.2D Uses division to find unit rates and ratios in proportional relationships such as speed and density.  
7.9 Solves application problems involving estimation and measurement.  
8.1B Selects and uses appropriate forms of rational numbers to solve real-life problems including those involving proportional relationships.  
Science: 6,7,8.1B Conducts field and laboratory investigations using safe, environmentally appropriate and ethical practices.  
6,7,8.2 Uses scientific inquiry methods during field and laboratory investigations.  
6,7,8.4 Knows how to use a variety of tools and methods to conduct scientific inquiry.  
8.7 Knows that there is a relationship between force and motion.

 **Essential Terms:**  
*acequia*, labores, erosion, slope of land, velocity and size terms: clay, sand, silt

## ENVIRONMENTAL ACTION

**Big Idea**  
**How do environmental factors such as soil types affect the *acequia*?**

### Objectives

Students will:

- ◆ Find the rate water soaks into the ground near the fields.
- ◆ Measure the size of particles in soil and relate that to water absorption.
- ◆ Find the percent composition for each particle size of the soil and relate that to the type of soil.
- ◆ Prepare a written report using the data and conclusions of the investigations.
- ◆ Present a report summarizing the data and conclusions to the class.
- ◆ Record data in San Antonio Mission Historical Park's database.

### Making Connections

Students will investigate the interaction of the water and the materials surrounding Mission Espada's *acequia*. The slope of the land and the composition of the surrounding land affect the velocity of the water in the *acequia*. The volume of water flowing into the *acequia* is controlled by rain fall and spring water. The velocity affects the amount and size of sediments carried and deposited in the *acequia*'s water. The type of bottom material affects the amount of water soaking into the ground. Water runs off quickly on impermeable soil. It runs more slowly on permeable soil because the water will percolate into the soil. The velocity of the water will determine whether the bottom of the *acequia* is eroded or whether the water is stagnant and not eroded.

In the 1700s, a *labore*, or section of farmland, was approximately 177 acres in size (Rock, 1993). This was further divided into strips of land that could be worked by individuals.

Before planting in the spring, the mission Indians cleaned the *acequias* of debris and silt. Repairs might need to be made also. Falling tree branches or wild or domesticated animals might have done damage. The water gate at the start of the *acequia madre* (main *acequia*) would be closed to stop the flow of water downstream in the *acequia*.

## Materials

The following are needed:

- ◆ pint jar
- ◆ metric ruler
- ◆ juice can opened at both ends (smooth with emery cloth)
- ◆ liter of water in plastic jug
- ◆ U.S. Department of Agriculture Soil Triangle
- ◆ plastic bags
- ◆ digging tools
- ◆ stream table(optional)

## Engagement (Pre-visit):

Brainstorming: How does the type of material exposed at the surface of the bedrock affect the movement of the water in the *acequia*? (Except for the section that goes by means of an aqueduct, the *acequia* has a bottom made of dirt.) How would a dirt surface affect the flow of water? How could one find out? What could cause the *acequia* to need repair? Use “Making Connections” or multimedia resources to answer the question, if necessary.

## Exploration (Pre-visit):

1. What makes up the composition of the soil at your school campus? Procedure for determining soil types:
  - a. Observe soil from the schoolyard using a hand lens. Record observations of color and lumpiness.
  - b. Feel the dry soil between your fingers. Grittiness indicates sand particles. If it feels like flour or talcum powder, clay particles are indicated. If it feels like homemade tooth power of baking soda and salt (somewhere

between sand and clay), then it is a silt soil.

- c. Take a sample of soil; sprinkle it with water and knead it to form a ball; apply pressure to the ball with your thumb. If it flattens and has an imprint of your thumb, it is probably a clay loam. If the ball breaks apart, it is silty loam. If it does not form a ball with the sprinkling and kneading, it is sandy loam.
  - d. Record your hypothesis of the type of soil found at the school campus.
2. What amount of each type of sediment is found in the soil? Make a hypothesis. Procedure to determine the quantity of each soil type:
    - a. Fill a pint jar one-half full of soil. Add water until the jar is two-thirds full.
    - b. Put the lid on the jar tightly and shake vigorously.
    - c. Allow the sediments to settle. Observe the type of sediments in the layers. Of clay, silt, and sand types, which is on the bottom?
    - d. Measure the amount of each kind of sediment in the jar using the meter stick or a smaller plastic ruler. Measure the total amount of sediment. (The pieces of plants are humus.) Record the data.

- e. Calculate the percent composition of sand, silt, clay and humus by the following formula:  

$$\frac{\text{height of a layer} \times 100\%}{\text{total height of soil in jar}}$$
 Do this for each size layer. Record the results.
- f. Using the U.S. Department of Agriculture soil triangle and the percent composition data, classify the soil. To name the soil, follow the edge of the triangle until you find the percentage for each type of soil. As soon as each percentage is found on the outside of the triangle, follow the lines as they move inside and cross the triangle. At the point where the lines cross one another, is the name of the soil.

3. Make a hypothesis about the factors that affect how fast water can be absorbed into the soil. [Possible hypotheses: size of soil particles, whether it has rained recently, the rate rain is falling, or rate water from *acequia* is flowing over the substrate.] Procedure to determine how long it takes for soil to absorb a given amount of water:

- a. Measure 5 cm from the end of the large juice can and mark it.
- b. Push the can into the ground to the 5-cm mark, using a board and a hammer if necessary.
- c. Pour 1 liter of water into the can and time how long it takes to be absorbed. Remove the can. Record the data.
- d. Repeat two more times in different places. Calculate the average time required for the water to be absorbed. Record your data.

### Elaboration (Mission Visit):

[Prior to the visit to San Juan's *labores* and to Espada's *acequia* assign each student team to one of these tasks:  
 #1 Determine the type soil in each sample.  
 #2 Determine the quantity of each soil type.  
 #3 Determine the time it takes for water to be absorbed into the soil.]

What are the characteristics of the soil at San Juan's *labores* and on the bottom of Espada's *acequia*?

1. Procedure for teams with tasks #1 and #2:
  - a. Collect soil samples at the following sites and place in the plastic bag:
    - ♦ At the edge of San Juan's *labores* (fields)
    - ♦ At the bottom of the Espada aqueduct
 CHECK WITH THE RANGER FOR THE PROPER SITE. DO NOT CROSS THE CREEK.
  - b. Complete the investigation in the classroom.
2. Procedure for teams with task #3:
  - a. Collect data at the same sites as teams one and two.
  - b. Complete the analysis of the data in the classroom.

### Notes:

## Elaboration (Post-visit)

1. Analyze and record the data collected.
  - a. Teams with task #1:  
Determine the types of soil found at San Juan's *labores* and Espada's *aqueduct*.
  - b. Teams with task #2:  
Determine the quantity of each type of soil sediment found at San Juan's *labores* and Espada's *aqueduct*. Calculate the percentage of each type. Using the U.S. Department of Agriculture Soil Triangle classify the soil.
  - c. Teams with task #3:  
Calculate the average time it took the water to absorb at San Juan's *labores* and Espada's *aqueduct*.

2. As a class discuss the answers to these questions:
  - a. How does the soil type differ in each of the two sites at the Mission?
  - b. How does the % of composition of soil at bottom of the aqueduct differ from the soil in the *labores*?
  - c. How does the time for water absorption differ at each site?
  - d. How would you explain the differences that were observed?
  - e. How does the soil at the missions compare with the soil on the school campus?

## Evaluation (Post-Visit)

1. Complete a written report from the mission investigations that includes the data and the conclusions. Use the general rubric for lab reports (Alter as needed).
2. Present an oral report to the class that summarizes the data and conclusions from the Mission investigations. Use rubric for oral reports.
3. Record data in San Antonio Missions National Historical Park 's databank.

Possible extension:  
Erosion is a problem. If a stream table is available, design an investigation to determine factors that alter erosion. Consider such factors as slope, particle size and type, and velocity.

U.S. Department of Agriculture  
Soil Triangle

